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(54) IMAGE DECODER PROVIDED WITH FRAME RATE CONVERSION FUNCTION

(57)Abstract:
PURPOSE: To display the reproduced image by being conformed to a display monitor even if the frame rates of an input bit stream and the data to be displayed and outputted are different.
CONSTITUTION: When the image data after a decoding to be displayed next is already stored in frame memories 72 and 73the image data is displayed. When this image data is not storedwhether the image data before the decoding to be displayed next is within a buffer memory 7 and the reference image data necessary for decoding this image data is stored in frame memories 72 and 73 or not are decided. When the reference image data is storedthe data is immediately decoded and the image data is displayed. When all these conditions are not satisfiedthe image data displayed just before is redisplayed.

CLAIMS

[Claim(s)]
[Claim 1]A device which decodes coded image datacomprising:

Mode holding mechanism which holds it when the number of pictures per second in an input coding stream is in a relation slightly less than the number of display output pictures.
A frame memory condition determining means which judges whether image data after decoding which should be displayed on the next present on display is already stored in a frame memory.
image data before decoding which should be displayed on said next -- the inside of a buffer memory -- and a buffer memory condition determining means which judges whether image comparison data required to decode said image data is already stored in a frame memory.
A redisplay means which carries out redisplay of the image data displayed immediately before if data required to display the following picture in said frame memory and said buffer memory by a decision result of said frame memory condition determining means and a buffer memory condition determining means was not assembled.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the image decoding device with a frame rate conversion function which can decode an image by a different frame rate from the coded picture signal.
[0002]
[Description of the Prior Art]When transmitting or accumulating the image data by which digital representation was carried outcoding is performed in order to reduce data volume. There is the method of lessening relative redundancy as the method of coding using the time or spatial correlativity of picture information (image data).
[0003]There are some which code the difference of two continuous screens (frame) as a method of using time correlativityor detect a motion of a picture and perform a motion compensation. moreover -- as the method of using spatial correlativity -- a picture -- the block (for examplea lengthwise direction.) of a predetermined size It divides the horizontal method into 8 pixels at a timeit carries out orthogonal transformation of the data within a blockcarries out scan conversion of the conversion factor (for exampleit rearranges in order of a high frequency component from a low-frequency component)and has some which perform variable length coding. The image coding system (it abbreviates to MPEG 2 hereafter) with which MPEG (Moving Picture Experts Group) is advancing standardization is using the two above-mentioned methods together. This is indicated to ISO/IEC 1381-2 entitled provisional advice "Generic Coding of Moving Pictures and Associated Audio" of MPEG 2.

[0004]Drawing 3 is an example of composition of the conventional image decoding device.
The decode processing means A and the display processing means B are comprised. The input bit stream 100 which is a bit string of the coded data is inputted into the decode processing means Aand the reproduced image 200 is outputted after decoding. The display processing means B performs a conversion process so that it may be suitable for a display monitor in said reproduced image 200and the generating picture 300 is outputted. In MPEG 2the contents of processing which should be performed by the decode processing means A are specifiedand it has not set about display processing.
[0005]Drawing 4 is an example of composition of the decode processing means A of the picture of drawing 3. Decoding processing is performed by the buffer control part 10the variable length decoder 20the scan conversion machine 30the inverse quantization device 40reverse DCT section 50and the motion compensation image restoration part 60 in drawing 4. 71 is a buffer memory and 7273and 74 are frame memories (memory of the three frames mentioned laterIPand the B frame). As for dataand 83 and 84reproduction picture element data and 86 are B frame image data prediction frame data or prediction field dataand 85 81 and 82andas for the input bit stream for which 100 expresses the coded pictureand 200a reproduced image is shown.
[0006]Nextoperation is explained. The input bit stream 100 is accumulated in the buffer memory 71 by control of the buffer control part 10 as the data 81. Variable-length decoding of the data 82 read from the buffer memory 71 is carried out by the variable length decoder 20.
[0007]Although variable length coding of all the data is not necessarily carried outa fixed length code shall also be decoded with this variable length decoder 20. Nextinverse quantization is carried out by the inverse quantization device 40 after rearranging an order of data with the scan conversion machine 30. Nexta reverse discrete cosine transform is carried out by reverse DCT section 50. In the motion compensation image restoration part 60reproduction in consideration of a motion of a picture is performed. In MPEG 2a middle frame (here the B frame) is predicted in time to be a front frame (here the I frame) from both next frames (here p frames). Thereforeit is necessary to read the prediction frame data 83 and 84 of the I frame and p frames decoded beforehand to reproduction of the B frame from the frame memories 72 and 73 (in MPEG 2next p frames are decoded in advance of the B frame in time). There is field prediction other than the above-mentioned frame prediction in a prediction procedureField prediction as well as frame prediction predicts the middle field (here B field) in time to be the front field (here I field) from both next fields (here P field). The B frame or B field is reproduced in the motion compensation image restoration part 60 according to the prediction error which is an output of prediction frame data or the prediction field data 83 and 84and reverse DCT section 50and it is

written in the frame memory 74 as the reproduction picture element data 85. The frame of IPand B in the frame memories 72 and 73 and 74 is read from each memory in predetermined order (B frame image data 86 is read in drawing 4)and the reproduced image 200 is outputted.
[0008]In the display processing means B of drawing 3processing of the noise rejection of the reproduced image 200frame rate conversionetc. is made.
[0009]Hereafterconversion of a frame rate is described. For examplethe movie comprises 24 frames in 1 second.This is codedand in order to decode again and to obtain PAL and a reproduced image of 25 frames per second (50 fields / second) like SECAMthe two following methods can be considered.
[0010]The 1st method is a method premised on obtaining the reproduced image 200 of 25 frames per second at the time of coding. Although this is not necessarily commonthe stream syntax top of MPEG 2/video is possible. It applies 3 1-time field circumference terms in 1 / 2 seconds at the time of decodingand one frame is decodedone frame is displayed the 3 fieldsit usually passes by a reproduced image output only thenand the 2 fields of other periods express it as it. A decoding start is made into an unequal intervalor the change of 2 field displays / 3 field displays is put in as information on the repeat first field (repeat_first_field) in a bit stream at the time of coding.
[0011]A frame rate is not changed at the time of codingbut it codes by 24 frames per secondand the 2nd method is decoded as it isand obtains the reproduced image 200. The decoding start time of each frame is regular intervalsand the information on the repeat first field is disregarded. In this casefor acquiring the picture of 25 frames per secondframe rate conversion must be carried out by the above-mentioned display processing means B. Using a frame memory the 2nd [or more] pagethe general method reads the frame before [one] being written in the 2nd page by 25 frames per second (interlace) for a displaywhile writing in the 1st page by 24 frames per second (PUROGURESHIBU). In that caseit is [as seeming / reading processing / not to pass writing processing] necessary to read an identical field to 1 / 2 seconds twiceand to adjust it to them at 1 time of the ratelike the 1st method.
[0012]
[Problem(s) to be Solved by the Invention]Since it is at the coding time and a display monitor's frame rate is beforehand fixed to PAL/SECAM in the 1st method of the conventional technology mentioned aboveThe degree of display monitor option is lostand in the decoding device which connected the monitor of NTSC or a personal computereven if it can decode a bit streaman image cannot be seen.
[0013]In the 2nd methodthe frame rate converter which carries the 2nd [or more] page of an expensive frame memory in the exterior of a decode processing means will be needed.
[0014]An object of this invention is to cancel the fault of a device conventionally [above]and to be able to generate the reproduced image set by the display monitor

which has connected by the decoding processing sideand for a cost hike to provide few image decoding devices.
[0015]
[Means for Solving the Problem]An image decoding device concerning this invention is provided with the following.
Mode holding mechanism in which it judges it when an input coding stream has the number of input frames per second in a relation slightly less than an output frame numberand it holds the resultfor example by 24 frames per second like [in case a display output is an object for 25 frames per second].
Nexta frame memory condition determining means which judges whether image data after decoding which should be displayed is already stored in a frame memory.
Nexta buffer memory condition determining means which judges whether image data before decoding which should be displayed is already stored in a buffer.
A redisplay means which carries out redisplay of the image data displayed immediately before if data required to display the following picture in a frame memory and a buffer memory is not assembled.

[0016]
[Function]In this inventionwhen judging whether the image data of the frame which should be displayed on the next based on the decision result of a frame memory condition determining means has gathered when the value beforehand provided in mode holding mechanism is set up and not having gatheredthe output of a buffer memory condition determining means is investigated. If the image comparison data which needs the decoding previous image data of the frame which should be displayed on the next to have gathered in the buffer memory and decode it also exists in a frame memorywill perform decoding and display processing promptlyand if that is not rightBy the above-mentioned redisplay meansredisplay of the frame in front of a frame present on display is carried out. Simple frame rate conversion is attained without this newly forming a frame rate converter outside.
[0017]
[Example]The example of this invention is described using drawing 1 and drawing 2. Drawing 1 is a block diagram showing the composition of one example of this invention. Drawing 2 shows the outline timing of decoding and the contents of processing which carry out a repeat display for the input bit stream for about 1 second by this example.
[0018]In this examplethe input bit stream is coded by the plog RESHIBU sequence 24 frame per secondthe display monitor assumes the interlace 25 frame per secondand GOP (Group of Pictures) structureIt is explaining as BBIBBP (in B picturethe picture of six sheets exists by the following I picture from two sheets and I picture between I or P picture).
[0019]In drawing 1the same name and the number were given to the component and

identical configuration element which were explained by drawing 4 of the conventional example. The component newly added from drawing 4The mode register 61 in the motion compensation image restoration part 60the display clock generating part 62the vector decoding part 63the frame memory reading-and-writing control section 64 and the coded representation mode signal 11the buffer memory condition signal 12the 24:25 conversion mode flag 65They are four signal wires of the display frame periodic signal 66.

[0020]On the other handin drawing 2the input bit stream 100 is input data to the buffer control part 10 shown in drawing 1. The above-mentioned bit stream data stored in the buffer memory 71 with decoding processingIt doubles with a display monitor's frame period (1 / 25 seconds) from the buffer memory 71It reads per frame and processing time until it writes regenerative data in the frame memories 7273and 74 through the variable length decoder 20the scan conversion machine 30the inverse quantization device 40reverse DCT section 50and the motion compensation image restoration part 60 is shown.

[0021]The writing of the frame memory in drawing 2 and read-out express the writing of a reproduced imagereference read-outand a display read-out sequence using an arrow for contents of processing of frame memory reading-and-writing control section 64 in applicable frame periodi.e.IPand B each picture of every. The arrow out of which the arrow with which the arrow of the direction included in each memory comes out of the writing of a reproduced image to a lengthwise direction comes to read-out as an image comparison and a transverse direction means read-out for a display. The reproduced image 200 is an outputted image obtained as a result of the processing mentioned above.

[0022]Nextoperation of this example is explained using drawing 1 and drawing 2. In drawing 1through the buffer control part 10the input bit stream 100 is a rate of 24 framesand is continuously stored in the buffer memory 71 in 1 second. Howeversince coding modes usually differ for every picture of IPand Bgenerated code amounts differ. the frame rate by which the buffer control part 10 is contained in a streamthe frame structureand a plog RESHIBU sequence ****** -- etc. -- it analyzes and tells the mode register 61 via the coded representation mode signal 11. The buffer control part 10 is provided also with the function as a memory information judging meansThe picture start code which shows the head of each frame of coding data to frequent is countedIt supervises whether the coding data for what frame is stored in the present buffer memory 71and the frame memory reading-and-writing control section 64 is told about the result via the buffer memory condition signal 12. On the other hand in the motion compensation image restoration part 60an input from the scan frequency of the information from the coded representation mode signal 11and the display monitor under present connection by PUROGURESHIBU display 24 frame per second. And if a display output is 25 frames per secondsuch as PAL24:25 conversion modes will be set as the mode register 61 which functions as mode holding mechanismIt tells the buffer

control part 10 and the frame memory reading-and-writing control section (it functions as a frame memory condition determining means and a redisplay means) 64 by making the result into the 24:25 conversion mode flag 65. In this modeVBV delay (Video Buffering Verifier Delay) or DTS (Decoding.) as which the buffer control part 10 specifies the read timing from the buffer memory 71 described in the stream It is not necessarily caught by the value of Time Stampfor exampleis referred to only at the time of a program receiving startand after itaccording to the display frame periodic signal 66it reads in order to decode coding data by an one-frame minute unit from the above-mentioned buffer memory 71. Usuallyvariable-length decodinginverse quantizationreverse DCTmotion image compensationetc. are processed in real timeand the read coding data is written in the frame memory respectively decided by the kind (IPB) of picture. Howeverto an input being 24 frames per secondsince an output is 25 frames per secondthe pause of decoding produces it at a rate of one frame at 1 second. This is the period when decoding processing was shown by x in drawing 2. At this timethe frame memory reading-and-writing control section 64 controls a reproduced image output according to the following priorities.

[0023](1) It will be displayed if the data for one frame of the turn which should be displayed on the frame memories 72-74 is assembled first. (2) Nextthe coding frame data (usually B picture) of the turn which should be displayed on the buffer memory 71 is together with all of one frameand displaydecodingif the image comparison required to decode it is equal to the frame memories 72 and 73. (3) If the above (1) and (2) is dissatisfiedit carries out redisplay of the frame displayed immediately before.

[0024]As shown in drawing 2when the coding data for one frame has not been stored yet in the buffer memory 71While stopping decoding processing temporarilythe frame memory reading-and-writing control section 64Nextit is checked first whether the reproduced image data which should be displayed is already stored in the object for Ior the frame memories 72 and 73 for P (since only I or P picture is decoded a priori and is already stored in the frame memory as an image comparison). If it existsthe frame will be outputted as the reproduced image 200. At this timeif it does not exist in the frame memories 72 and 73the frame memory reading-and-writing control section 64 outputs again the frame outputted immediately before for a display. The buffer control part 10 checks that the coding data for one frame has been equal to the above-mentioned buffer memory 71and decodes the frame at the frame period after stopping decoding once. If this decode data is B picturethe frame memory reading-and-writing control section 64 will output it as the reproduced image 200 promptly. On the other handif it is not B picturethe re output of the data of the frame displayed immediately before will be carried out.

[0025]Although this example described the case where the display output of the input stream of 24 frames per second was carried out by 25 frames per secondsuch as PAL/SECAMIf the frame rate of input data is lower than an output frame rate about several or lesspercenteven if it applies to the apparatus which has a displaying frame

rate original with a personal computera communication terminaletc.for exampleit will be satisfactory practically. Although BBIBBP also explained GOP structure by this exampleit is just going to understand that the same effect is acquired in other combination easily [a person skilled in the art].

[0026]

[Effect of the Invention]As explained abovethe image decoding device by this inventionWhen the number of pictures per second in an input coding stream is in a relation slightly less than the number of display output picturesThe frame memory condition determining means which judges whether the image data after decoding which should be displayed on the next present on display as the mode holding mechanism holding it is already stored in the frame memoryThe image data before decoding which should be displayed on said next in a buffer memory And the buffer memory condition determining means which judges whether image comparison data required to decode said image data is already stored in the frame memorySince it has a redisplay means which carries out redisplay of the image data displayed immediately before if data required to display the following picture in said frame memory and a buffer memory by the decision result of said frame memory condition determining means and a buffer memory condition determining means is not assembledfor exampleSince redisplay of the same frame is carried out at the time of underflow and the stream coded by the plog RESHIBU sequence 24 frame per second can be outputted as reproduced images of 25 frames per secondsuch as a direct PAL systemby frame memory control and buffer controlSince it is also unnecessary to add to specify a display monitor beforehand at the time of codingan outside expensive frame rate converteretc.the increase in cost and circuit structure can be pressed down to the minimum.

[0027]It is possible to change also by the case of 23.976 frames per second the input is accepted to be not by 24 frames per second but by MPEG 2without adding a hand in any way.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a block diagram showing the composition of one example of this invention.

[Drawing 2]It is a figure showing the outline timing of decoding and the contents of processing which carry out a repeat display for the input bit stream for about 1 second in one example of this invention.

[Drawing 3]It is a block diagram showing the example of composition of the conventional image decoding device.

[Drawing 4]It is a block diagram showing the details of the composition of the decode

processing means in drawing 3.

[Description of Notations]

10 Buffer control part
11 Coded representation mode signal
12 Buffer memory condition signal
20 Variable length decoder
30 Scan conversion machine
40 Inverse quantization device
50 Reverse DCT section
60 Motion compensation image restoration part
61 Mode register
62 Display clock generating part
63 Vector decoding part
64 Frame memory reading-and-writing control section
65 24:25 conversion mode flag
66 Display frame periodic signal
71 Buffer memory
72 Frame memory
73 Frame memory
74 Frame memory
81 Data
82 Data
83 Prediction field data
84 Prediction field data
85 Reproduced image data
86 B frame image data
100 Input bit stream
200 Reproduced image